UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/661,237	09/12/2003	Patrick G. Xavier	6909.1/97535	6847

				EXAMINER
20567	7590	07/28/2006		JACOB, MARY C

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ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)
Office Action Summary	10/661,237	XAVIER, PATRICK G.
	Examiner	Art Unit
	Mary C. Jacob	2123

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 September 2003*.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
    Paper No(s)/Mail Date *9/12/03*.

4)☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

1.   Claims 1-20 have been presented for examination.

Drawings

2.   The subject matter of this application admits of illustration by a drawing to

facilitate understanding of the invention. Applicant is required to furnish a drawing

under 37 CFR 1.81(c). No new matter may be introduced in the required drawing.

Each drawing sheet submitted after the filing date of an application must be labeled in

the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR

1.121(d).

Claim Rejections - 35 USC § 112

3.   The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of
> making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the
> art to which it pertains, or with which it is most nearly connected, to make and use the same and shall
> set forth the best mode contemplated by the inventor of carrying out his invention.

4.   Claims 1-20 are rejected under 35 U.S.C. 112, first paragraph, as failing to

comply with the enablement requirement. The claim(s) contains subject matter which

was not described in the specification in such a way as to enable one skilled in the art to

which it pertains, or with which it is most nearly connected, to make and/or use the

invention. The specification states the following: "...the method of the invention can be

practiced on control apparatuses for robotic hardware, such as an internal or external

microprocessor programmed with software embodying the method of the invention..."

(page 26, lines 6-10). Wherein the "microprocessor programmed with software" could be interpreted as a computer readable medium, the specification fails to recite the execution of the microprocessor which would enable functionality of the claimed subject matter.

5.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6.   Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7.   Claims 1 and 20 recite the limitations "the volumes" and "the bounding volume hierarchy (BVH) representations" in step e. There is insufficient antecedent basis for this limitation in the claim.

8.   Claim 14 recites the limitations "said one or more first convex geometric primitives", "said one or more second convex geometric primitives" in step a. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 101

9.   35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

10.   Claims 1-20 are rejected under 35 U.S.C. 101 because the claimed invention is

directed to non-statutory subject matter.

11.   Claims 1-19 are directed to a computational/mathematical algorithm that

constitutes an abstract idea. Further, the claims fail to recite a concrete, useful or

tangible result.

12.   Claim 20 is directed to "computer software" per se, which is functional descriptive

subject matter, and the claim fails to recite a computer-readable storage medium storing

the computer software to realize the functionality of the software. Further, the claim is

also directed to a computational/mathematical algorithm that constitutes an abstract

idea and fails to recite a concrete, useful or tangible result.

Claim Rejections - 35 USC § 103

13.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

14.   Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Xavier (U.S. Patent 6,099,573) in view of Cowsar et al (US Patent 6,285,372).

15.   As to Claims 1 and 20, Xavier teaches: A method for clearance detection that

maps motions of a first body and a second body for detecting a clearance between the

first body and the second body, wherein the first body undergoes a first motion and the

second body undergoes a second motion, means for performing the method comprising the steps of (Figure 2 and description):

a) employing a first representation for the first body (Figure 1, element 11; column 4, lines 6-8);

b) employing a second representation for the second body (Figure 1, element 11; column 4, lines 6-8);

c) employing a first mapping of the first motion (column 4, lines 37-44; column 8, line 63-column 9, line 1);

d) employing a second mapping of the second motion (column 4, lines 37-44; column 8, line 63-column 9, line 1);

e) employing a hierarchical minimum distance search with respect to the volumes virtually swept by the bounding volume hierarchy (BVH) representations of the first and second body under their respective motions (column 4, lines 38-41; column 6, line 47-column 7, line 2; column 8, lines 50-60; column 9, line 62-column 10, line 25);

f) applying the first mapping to a first direction vector and the first representation to determine a first directionally furthest location on a first volume virtually swept by a node in the BVH representation of the first body during the first motion (column 7, lines 21-36);

g) applying the second mapping to a second direction vector and the second representation to determine a second directionally furthest location on a second volume virtually swept by a node in the BVH representation of the second body during the second motion (column 7, lines 21-36); and

h) detecting a clearance between the first body and the second body (Table 4).

16.   As to Claim 2, Xavier teaches: the step of determining a size of the clearance

(Table 4; column 9, lines 64-66).

17.   As to Claim 3, Xavier teaches: the step of determining collisions (column 9, line

64-column 10, line 2; column 10, lines 9-20).

18.   As to Claims 4-7, Xavier et al teaches (Claim 4) the first motion comprises a first

translation concurrent with a first rotation and the second motion comprises a second

translation concurrent with a second rotation; (Claim 5) the first motion comprises a first

translation, and the second motion comprises a second translation; (Claim 6) the first

motion comprises a first rotation, and the second motion comprises a second rotation;

(Claim 7) the first motion comprises a rotation, and the second motion comprises a

translation (column 3, lines 64-67; column 4, lines 11-19).

19.   As to Claim 8, Xavier teaches: wherein clearance detecting is time-dependent

(column 3, lines 18-22; column 14, lines 23-34; column 14, lines 60-63).

20.   As to Claims 9 and 12, Xavier teaches: wherein applying the first mapping to a

first direction vector and the first representation to determine a first directionally furthest

location on a first volume virtually swept during the first motion comprises:

a) determining a first BVH representation from the first representation, wherein the first

BVH representation comprises a first tree of nodes, each of which is a convex

geometric primitive (column 4, lines 26-30; column 9, lines 16-32);

b) applying the first mapping to the first direction vector and c) determining a

directionally furthest location on the first volume virtually swept by one of the one or

more of the geometric primitives of the first tree of nodes during the first motion using the first mapping (column 4, lines 37-44; column 5, lines 5-20; column 7, lines 21-30).

21.   As to Claims 10 and 13, Xavier teaches: wherein applying the second mapping to a second direction vector and the second representation to determine a second directionally furthest location on a second volume virtually swept during the second motion comprises:

a) determining a second BVH representation from the second representation, wherein the second BVH representation comprises a second tree of nodes, each of which is a convex geometric primitive (column 4, lines 26-30; column 9, lines 16-32);

b) applying the second mapping to the second direction vector and c) determining a second directionally furthest location on the second volume virtually swept by one of the convex geometric primitives of the second tree of nodes during the second motion using the second mapping (column 4, lines 37-44; column 5, lines 5-20; column 7, lines 21-30).

22.   As to Claim 11, Xavier teaches: wherein detecting a clearance between the first body and the second body comprises:

a) computing a distance between a first convex hull of the first volume virtually swept by one of the convex geometric primitives of the first tree of nodes during the first motion and a second convex hull of the second volume virtually swept by one of the convex geometric primitives of the second tree of nodes during the second motion (column 5, lines 51-60; column 6, line 66-column 6, line 14); and

b) repeating the computing step for another of the convex geometric primitives of the first tree of nodes and another of the convex geometric primitives of the second tree of nodes (Table 2; column 6, lines 47-61).

23.   As to Claim 14, Xavier teaches: wherein detecting a clearance between the first body and the second body comprises:

a) computing a distance between a first convex hull of the first volume virtually swept by one of said one or more first convex geometric primitives during the first motion and a second convex hull of the second volume virtually swept by one or more second convex geometric primitives during the second motion (column 5, lines 51-60; column 6, line 66-column 6, line 14); and

b) repeating the computing step for another of said one or more first convex geometric primitives and another of said one or more second convex geometric primitives of the second tree of nodes (Table 2; column 6, lines 47-61);

c) determining a shortest distance of said distances to determine the clearance size (column 6, lines 52-61).

24.   As to Claim 15, Xavier teaches: wherein detecting a clearance between the first body and the second body comprises:

a) computing a distance between a first convex hull of the first volume virtually swept by one of said one or more first convex geometric primitives during the first motion and a second convex hull of the second volume virtually swept by one of Said one or more second convex geometric primitives during the second motion (column 5, lines 51-60; column 6, line 66-column 6, line 14);

b) repeating the computing step for either or both of another of said one or more first

convex geometric primitives and another of said one or more second convex geometric

primitives (Table 2; column 6, lines 47-61); and

c) determining a shortest distance of said distances to detect a collision (column 6, lines

52-61).

25.   As to Claim 16, Xavier teaches: wherein determining a size of the clearance

comprises:

a) determining a first point on the first representation representing a shortest distance

(column 6, lines 12-14, lines 32-34, lines 41-46, 52-58);

b) determining a second point on the second representation representing the shortest

distance (column 6, lines 12-14, lines 32-34, lines 41-46, 52-58); and

c) calculating the size of the clearance (column 6, lines 50-63).

26.   As to Claim 17, Xavier et al teaches: wherein determining a collision comprises:

a) determining a first point on the first representation representing a shortest distance

(column 6, lines 12-14, lines 32-34, lines 41-46, 52-58);

b) determining a second point on the second representation representing the shortest

distance (column 6, lines 12-14, lines 32-34, lines 41-46, 52-58); and

c) calculating the size of the clearance (column 6, lines 50-63).

27.   As to Claim 18, Xavier teaches: wherein one or more of the convex geometric

primitives of the first tree of nodes is selected from the group consisting of convex

polyhedra, the method additionally comprising the steps of:

a) determining the directionally furthest point of a polyhedron's virtually swept volume by determining a directionally furthest vertex on that polyhedron with respect to an initial image of the first direction vector under mapping (column 7, lines 21-25; column 8, lines 52-column 9, line 3);

b) determining a transition of the directionally furthest vertex to an edge-adjacent vertex on that polyhedron due to motion of the mapped first direction vector (column 7, lines 23-28, lines 37-44; column 9, lines 4-5); and

c) determining subsequent changes of the directionally furthest vertex to an edge-adjacent vertex on that polyhedron due to motion of the mapped first direction vector (column 7, lines 37-44; column 9, lines 4-15).

28.   As to Claim 19, Xavier teaches: wherein one or more of the convex geometric primitives of the second tree of nodes is selected from the group consisting of convex polyhedra, the method additionally comprising the steps of:

a) determining the directionally 'furthest point of a polyhedron's virtually swept volume by determining a directionally furthest vertex on that polyhedron with respect to an initial image of the second direction vector under the mapping (column 7, lines 21-25; column 8, lines 52-column 9, line 3);

b) determining a transition of the directionally furthest vertex to an edge-adjacent vertex on that polyhedron due to motion of the mapped second direction vector (column 7, lines 23-28, lines 37-44; column 9, lines 4-5); and

c) determining subsequent changes of the directionally furthest vertex to an edge-

adjacent vertex on that polyhedron due to motion of the mapped second direction vector

(column 7, lines 37-44; column 9, lines 4-15).

29.   Xavier et al does not expressly teach inverse mapping.

30.   Coswar et al teaches a technique for generating parameterizations of irregular

connectivity meshes representing surfaces of arbitrary topology that can directly

construct an adaptively subdivided mesh, thereby avoiding excessive computation and

storage costs associated with the conventional approach of uniform subdivision followed

by sparsification (column 2, lines 40-42; column 3, lines 15-20). Coswar et al further

teaches the parameterization corresponds to the inverse of a function mapping each

point in the original mesh to one of the triangles of the base domain such that the

original mesh can be reconstructed from the base domain and the parameterization

(column 2, lines 47-52), wherein the inverse mapping is applied in remeshing

applications (column 11, lines 20-33).

31.   Xavier and Coswar et al are analogous art since they are both directed to

functions that map points from one representation of a surface of arbitrary topology to

another surface thereby constructing another representation of that data.

32.   It would have been obvious to one of ordinary skill in the art at the time the

invention was made to modify the mapping as taught by Xavier to include inverse

mapping as taught by Coswar et al since Coswar et al teaches a technique for

generating parameterizations of irregular connectivity meshes representing surfaces of

arbitrary topology that can directly construct an adaptively subdivided mesh, thereby

avoiding excessive computation and storage costs associated with the conventional

approach of uniform subdivision followed by sparsification (column 2, lines 40-42;

column 3, lines 15-20).

Conclusion

33.   The prior art made of record and not relied upon is considered pertinent to

applicant's disclosure.

34.   Jayaram et al (US Application Publication 2002/0123812) teaches a virtual

assembly design environment that simulates axial and planar constrained motion for

multiple parts in any combination and application order wherein dynamic simulation

methods are used to simulate object behavior in the design environment using physical

laws and collision detection algorithms.

35.   Ilies et al ("UNSWEEP: Formulation and Computational Properties", Proceedings

of the 4th ACM Symposium on Solid Modeling and Applications, pages 155-167, 1997)

teaches "sweep" and "unsweep" algorithms in geometrical modeling that account for

inverse motion.

36.   Sourin et al ("Function Representation for Sweeping By a Moving Solid",

Proceedings of the third ACM symposium on Solid modeling and applications,

December, 1995), teaches a function representation of point sets swept by moving

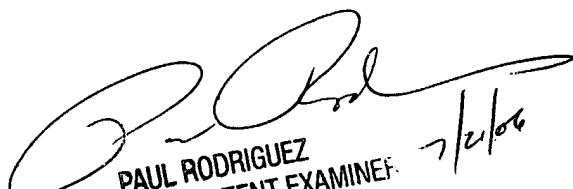solids and further teaches an inverse sweep algorithm.

37.   Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Mary C. Jacob whose telephone number is 571-272-

6249. The examiner can normally be reached on M-F 7AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Paul Rodriguez can be reached on 571-272-3753. The fax phone number

for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).

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Mary C. Jacob
Examiner
AU2123

MCJ
7/17/06

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